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Confined self-diffusion of lecithin in the lecithin-water system

Filippov A., Khakimov A., Doroginitskii M., Skirda V.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

The self-diffusion of lecithin molecules in a disperse system obtained by the mechanical mixing of lecithin with deuterated water was investigated by the pulsed magnetic-field gradient 1H NMR technique at 310 K. The experimental conditions were the following: the maximal gradient amplitude was equal to 50 T m-1, the diffusion time varied from 4.5 ms to 1 s, the lecithin concentration varied from 10 to 40%, and the residual diethyl ether content in the system was 3-6%. At all concentrations and diffusion times, the diffusion decay of spin-echo signals had a complex shape and was represented as a sum of two components corresponding to the "phases" characterized by completely confined and unconfined self-diffusion. The phase characterized by unconfined self-diffusion, on the basis of the character of its independence of the diffusion time and population, was assigned to protons of water and ether molecules. The behavior of the component whose shape depended on the diffusion time was quantitatively analyzed in terms of the model of self-diffusion of molecules in a thin spherical layer. To reach the best agreement between calculated and experimental diffusion decays, a bimodal distribution of spheres was introduced as the sum of two lognormal distributions. Parameters of these distributions were determined for all the investigated concentrations. The average radius of spheres for the mode characterized by larger radii is close to published values of the radius of vesicles formed in lecithin-water systems obtained by mechanical mixing.